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(54) METHOD FOR MANUFACTURE OF PRODUCTS CONTAINING DISALTS OF FORMIC ACID

VERFAHREN ZUR HERSTELLUNG VON PRODUKTEN, DIE BISALZE DER AMEISENSÄURE ENTHALTEN

PROCEDE DE FABRICATION DE PRODUITS CONTENANT DES BISELS D'ACIDE FORMIQUE

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(73) Proprietor: **NORSK HYDRO A/S
0240 Oslo 2 (NO)**

(72) Inventor: **HJORNEVIK, Leif
N-3714 Skien (NO)**

(74) Representative: **Allam, Peter Clerk et al
LLOYD WISE, TREGEAR & CO.,
Commonwealth House,
1-19 New Oxford Street
London WC1A 1LW (GB)**

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Description

[0001] The present invention relates to a method for manufacture of products containing disalts of formic acid. The products are manufactured from potassium-, sodium-, ammonium- and cesium- compounds and formic acid containing 0-50 % water in a reactor at 40-100°C.

[0002] It is often desired to have products with a high concentration of salts of monocarboxylic acids, and such products can be used for several purposes. In formate-based animal feed additives, for instance, it is desired that the formate concentration is high and that the product does not emit acids, which act corrosively and may cause poor working conditions during manufacture and handling of the products.

[0003] In order to obtain such concentrated products, at least part of the mono salts of said acids can be substituted with disalts like diformate

[0004] The mono salts of potassium, sodium, ammonium and cesium form disalts with monocarboxylic acids like, for instance, formic acid and acetic acid. The strength of the salt bonds decreases from cesium/potassium to ammonium Potassium diformates are stable crystalline salts which decompose at temperatures above 120°C. The ammonium diformates are less stable than potassium diformate and the decomposition temperature of ammonium diformate is reported to be in the range 25-30°C. The sodium diformates decompose in the temperature range 100-120°C

[0005] In Gmelins Handbuch der anorganischen Chemie, 8. Ed.System No. 21 and 22, Verlag Chemie G.M.B.H Berlin 1928, pages 818-857 and pages 919-949, respectively there is described formation of disalts of C_{1-4} monocarboxylic acids, like potassium diformate and sodium diformate by dissolving pure formates in concentrated and anhydrous formic acid. According to the described laboratory experiments, needle like crystals of diformates etc. are formed. The method for formation of disalts described in Gmelin are only theoretical. Commercial production of such disalts is not reported.

[0006] In GB-Patent No. 1.505.388 there is described the formation of aqueous solutions of complex salts from ammonium ions and/or ions of a metal selected from Group I and II of the Periodic Table and at least one carboxylic acid. The ratio of acid to ammonium and/or metal ions is in the range of 2:1 and 4:1 on a chemical equivalent basis. The concentration of water in the aqueous solution is between 15-75 % by weight of the total composition. Said solution of complex salts or disalts of carboxylic acids is stated to be a preservative composition useful in animal feed. This patent does not give any further operating conditions for making the solution of the complex salts and no conditions for making dry salts.

[0007] The main object of the present invention was to arrive at a new method for the manufacture of products containing disalts of formic acids, where large amounts of the products could be obtained in a form suitable for commercialisation.

[0008] Another object of the invention was to arrive at products comprising formic acid which were temperature stable, i.e. products where the loss of acid was kept at a minimum.

[0009] A further object of the invention was to arrive at a crystalline or granulated product which was free-flowing and possessed good storage properties.

[0010] Still another object of the invention was to arrive at a product which contains very small amounts of water, and appears with less hygroscopicity compared with the carboxylate itself.

[0011] Especially diformates of sodium and potassium were found to have such properties.

[0012] It was also an object to produce concentrated solutions or slurries of disalts of formic acid.

[0013] In its method aspects the present invention broadly provides a method for the manufacture of products containing disalts of formic acid, comprising mixing K-, Na-, Cs- or NH_4-formate, K-, Na- or Cs-hydroxide, K-, Na- or Cs-carbonate or bicarbonate or NH_3 with formic acid containing 0-50% water in a reactor at 40-100°C characterised in that the reaction is run until approximately 50-55% of the formic acid is consumed, the mixture is cooled and the slurry formed is filtered, the filtrate is collected or recirculated and the filter cake containing disalts is transported to a drier where the disalts are dried, and wherein optionally other disalts, calcium/ magnesium salts and/or a desiccant can be added to the drier.

[0014] Thus, in one embodiment, by using potassium hydroxide, carbonate, bicarbonate or formate, sodium hydroxide, carbonate, bicarbonate or formate, cesium hydroxide, carbonate, bicarbonate or formate or ammonium formate or ammonia, mixed with formic acid containing 0-30% of water, crystalline diformates can be manufactured. The manufactured crystalline diformates are easily separated from the suspension by centrifugation as a filter cake, and the filtrate containing acid salts collected. The filter cake can be transported by a transport belt/bucket conveyor to a drier/mixer where the wet diformate product is dried to a water content <0.2%. Calcium formate or other formates can be added to the drier/mixer. To further dehydrate the diformates, a desiccant can be added to the drier/mixer. Suitable desiccants will be various types of silica, starch etc. One preferred silica desiccant is sold under the trade name Sipernat 50/22 S. The crystalline diformates obtained are free-flowing, dry, stable, i.e. at normal storage temperature (0-80°C) they only decompose into acid and formate to a very small degree.

[0015] The preferred mole ratio of K, Na, or NH_4- formate and formic acid is 1-1.5 : 1-1.5. The temperature in the reactor should preferably be between 50-70°C, and the concentration of acid should preferably be in the range 50-100%. The drying temperature is preferably between 40 and 80°C, more preferably between 50 and 70°C. The filtration is preferably performed by means of

a centrifuge.

[0016] K/Na carbonates/hydroxides can be used in solid form and having a water content of 1-15%. Also, liquid and/or gaseous NH_3 or ammonium formate may be used.

[0017] A preferred process in accordance with the invention for making Na- or K-diformates can be performed by using only formic acid and NaOH or KOH as raw materials, although optionally Na- or K-carbonates can be used together with the respective hydroxides. This process comprises reacting a 80-95% aqueous solution of formic acid with a solution of 70-80% potassium or sodium formate at 50-60°C in a first reactor and subsequently cool the formed mixture to 20-25°C, whereby the formed diformate precipitates. The slurry containing the diformate is separated and the filtrate is transferred to a second reactor where it is reacted with a 50% solution of NaOH or KOH, which optionally may be mixed with the corresponding alkali carbonate. The thus formed formate solution is adjusted to pH 9-10 and then evaporated to a 70-80% solution which is transferred to said first reactor. The separated diformate solids are dried by means of air to a water content of <0.2% in a drier.

[0018] The new products of the present invention, which can be made according to the above method, comprise the following:

Disalts of formic acid containing	
20-60 %	potassium diformate
20-50 %	sodium di/tetra formate
0-25 %	calcium mono salt
0-4 %	desiccant
0-5 %	water

[0019] Another similar product according to the invention contains the following components:

60-90 %	potassium diformate
0-28 %	calcium mono salt
0-4 %	desiccant
0-5 %	water

[0020] The invention is further described with reference to the accompanying drawings, in which:

Figure 1 shows a flow sheet of an embodiment of the invention for manufacture or products containing disalts of formic acid; and

Figure 2 shows a flow sheet of an embodiment of the invention for producing diformates of potassium or sodium.

[0021] In Figure 1 a process for the manufacture of products containing disalts of formic acid is shown. Potassium hydroxide, carbonate, bicarbonate or formate, sodium hydroxide, carbonate, bicarbonate or formate, cesium hydroxide, carbonate, bicarbonate or formate or ammonium formate or ammonia 1 and 2 is mixed with formic acid 3 in which a small amount of water 4 is added, in a water-cooled agitator reaction tank 5 and 6 at 40-100°C, preferably 50-70°C. The reaction mixture is cooled to 20-40°C. Disalts are precipitated and the slurries 7 and 8 are led into centrifuges 9 and are centrifuged. The filter cakes 11 and 13 containing diformate crystals, are transported on a transport belt/bucket conveyor 14 to a drier/mixer 15. To the drier/mixer 15 additional formates, for instance calcium formate 16 and/or a desiccant 17, can be added. The calcium formate 16 and the desiccant 17 are first led into silos 18 and 19. The product 20 is collected from the drier/mixer 15. The filtrates 10 and 12 are collected from the centrifuge 9. Said filtrates can be applied as such in the form of concentrated solutions containing 55-70 % disalts or they can be further processed. The slurries 7 and 8 can be diluted by relinquishment of the filtrate 10 and 12 from the centrifuge 9 to the reaction tank 5 and 6 if desired.

[0022] Figure 2 shows forming disalts of Na or K by performing the reactions in two reactors 25, 27. In reactor 25 80-95 % formic acid 3 is reacted at 50-60°C with a 70-80 % solution 24 of Na/K formate being formed in reactor 27. The resulting solution is cooled to 20-25°C, whereby a coarse crystalline mass of diformate is formed and precipitated. This suspension has a solids content of 40-45 % depending on the final temperature during the cooling step. The diformate crystals are removed in a separating device 9, preferably a pusher centrifuge being designed to let crystals having a size below 70 micron get through. The crystal mass will thereby have a D_{50} of about 600 micron. Thus a dust free product is obtained. The filtrate 30 containing diformate in water and small amounts of crystals is pumped to reactor 27 where the acid part is neutralized with a 50 % solution of NaOH or KOH 28. A combination of the respective carbonates and a 50 % hydroxide solution can also be used. The crystals of the solution will be dissolved during this neutralization. Subsequent to neutralization to pH 9-10, the solution 33 is concentrated in evaporator 26 to which steam 22 can be supplied. The thus concentrated 70-80 % solution 24 is transferred to reactor 25. The crystal mass of diformates 32 from the separating device 9 contains about 1-1.5 % water and is transferred to a drier 15, which preferably is a paddle drier. In the drier 15 the diformate is dried to a water content <0.2 during 12-18 minutes by air 31 which leaves at 23. The thus dried product 20 can be mixed with a desiccant.

[0023] The present invention is further illustrated by the Examples which follow.

Example 1

[0024] This example shows manufacture of potassi-

um diformate.

[0025] 91 % KOH and 85 % formic acid are mixed in a water-cooled agitated reaction tank/crystallizer at 60-70°C to a conversion of the formic acid of about 50-55 %. The reactor is cooled down to 20-40°C. Potassium diformate is precipitated quantitatively and a slurry with about 50-55 % dry substance is formed. The slurry is centrifuged continuously to a water content of about 1.5-3 % by weight. The filter cake is transported via a transport belt/bucket conveyor to a drier/mixer, and a dry substance with about 0.1 % by weight of water is obtained. The content of formic acid is about 35 %. Other diformates, dry formates and/or a desiccant can also be added to the drier/mixer. The filtrate collected from the centrifuge can be used to dilute the slurry before centrifugation, if necessary. The collected filtrate can be further processed, i.e. by adding potassium hydroxide to the filtrate the formic acid in the filtrate will be converted to potassium formate solution.

[0026] Alternatively the potassium diformate can be manufactured in the same way from 85-95 % formic acid and 75 % potassium formate.

Example 2

[0027] This example shows manufacture of sodium di/tetraformate.

[0028] 80-90 % formic acid is mixed with 97 % NaOH dry substance in a water-cooled agitated reaction tank/crystallizer at 60-70°C to a conversion of the formic acid of about 50-55 %. The reactor is cooled down to 20-40°C, and a mixture of sodium diformate and trisodium tetraformate are quantitatively precipitated and a suspension of about 50 % is formed. The suspension is centrifuged to a water content of about 2-5 %. The filter cake is transported via a transport belt/bucket conveyor to a drier/mixer. The content in the drier/mixer is dried. The content of formic acid will appear at about 30 %. Other diformates, dry formates and desiccant can also be added afterwards to the drier/mixer.

[0029] The filtrate collected from the centrifuge can be used to dilute the suspension before centrifugation, if necessary. The filtrate can be further processed in the same way as stated in Example 1.

[0030] Alternatively the sodium diformate/trisodium tetraformate can be manufactured by dissolving sodium formate in 85-95 % formic acid in a mole ratio approximately 1:1. The slurry must be diluted with recirculated filtrate from the centrifugation step. In this case the filter cake is washed continuously with a small amount of diluted NaOH to neutralize the excess acid in the filter cake.

Example 3

[0031] This example shows the production of dry, free-flowing products with a high content of potassium diformate and sodium diformate/tetraformate. These types of products are here called Type 1 products.

[0032] Potassium diformate and sodium diformate/tetraformate are manufactured as shown in Examples 1 and 2. To the drier/mixer calcium formate, a desiccant, a silica product sold under the tradename Sipernat 50/22 S, and water are added. The composition of the mixture in the drier/mixer is :

Potassium diformate	49.3 % by weight
Sodium diformate/tetraformate	24.6 % by weight
Calcium formate	24.6 % by weight
Desiccant	1.0 % by weight
H_2O	0.5 % by weight

[0033] A product of the following total composition based on weight was formed :

Formic acid	22.4 %
Potassium formate	31.9 %
Calcium formate	24.5 %
Sodium formate	19.7 %
Desiccant	0.5 %
H_2O	1.0 %

[0034] The product contains about 20 % formic acid and about 64.8 % formate.

[0035] Similar Type 1 products can be manufactured as described in Example 3. They will be highly concentrated with regard to total content of formate (propionate etc.) due to the content of disalt of the monocarboxylic acid. Addition of calcium formate/acetate/propionate will depend on the actual use of the Type 1 product. The general composition of Type 1 products, when the acid applied is formic acid, will be :

Potassium diformate	20-60 %
Sodium di/tetra-formate	20-50 %
Calcium formate	0-25 %
Desiccant	0-4 %
Water	0-5 %

[0036] The primary application will be as feed additives.

Example 4

[0037] This example shows the production of dry, free-flowing products with a high content of potassium diformate. These types of products are here called Type 2 products.

[0038] Potassium diformate was manufactured as shown in Example 1. To the drier/mixer calcium formate, a desiccant and water are added. The composition of the mixture in the drier/mixer was :

Potassium diformate	88.0 % by weight
Calcium formate	11.0 % by weight
Desiccant	0.5 % by weight
H_2O	0.5 % by weight

[0039] A product of the following total composition based on weight was formed :

Formic acid	31.1 %
Potassium formate	56.9 %
Calcium formate	11.0 %
Desiccant	0.5 %
H_2O	0.5 %

[0040] The product contains about 30 % formic acid and about 65.6 % formate.

[0041] The Type 2 products formed as described above will have the following general composition when the acid applied is formic acid :

Potassium diformate	60-99 %
Calcium formate	0-28 %
Water	0-5%
Desiccant	0-4 %

[0042] The primary application will be as feed additives.

Example 5

[0043] This example shows preparation of potassium diformate in a process as schematically shown in Figure 2.

[0044] 85 % formic acid was reacted with a 75 % potassium formate in the first reactor 25 at about 55°C and subsequently cooled to 20-25°C, whereby a coarse crystalline potassium diformate mass was precipitated. The diformate was separated by centrifugation and contained at this point 1-1.5 % water which was further reduced in a drier to <0.2 % water. The filtrate containing potassium diformate and small amounts of crystals was pumped to the second reactor 27 where it was reacted with a 50 % potassium hydroxide solution, whereby the acid part of the diformate was neutralized. The pH of the solution was adjusted to pH 9-10 and then evaporated to a 75 % potassium formate solution which was transferred to reactor 25. The desiccant "Sipernat", a silicon dioxide, was added in amounts of 1-1-3 % to the dried potassium diformate.

[0045] Sufficient potassium is supplied during the neutralization in the second reactor to give the required mass balance with regard to potassium. Accordingly it is not necessary to supply any external potassium formate to this process, which only requires formic acid and hydroxide which optionally can be mixed with the corresponding alkali carbonate. The finished product was free-flowing and non-dusting and was ready for being packed in bags or delivered in bulk.

[0046] By the present invention we have arrived at a most flexible and economic process for manufacturing a whole range of highly concentrated products with regard to total content of salts of formic acid, and specifically disalts of formic acid. The main products are dry and free-flowing and possess excellent storage properties, they contain very small amounts of water, and they are temperature stable, i.e. the loss of acid is very small. Also the by-product filtrate, according to the process shown in Figure 1, can be applied as such or recirculated in the process for manufacture of the main product.

Claims

1. Method for the manufacture of products containing disalts of formic acid, comprising mixing K-, Na-, Cs- or NH_4-formate, K-, Na- or Cs-hydroxide, K-, Na- or Cs-carbonate or bicarbonate or NH_3 with formic acid containing 0-50 % water in a reactor at 40-100°C
   characterised in that
   the reaction is run until approximately 50-55 % of the formic acid is consumed, the mixture is cooled and the slurry formed is filtered, the filtrate is collected or recirculated and the filter cake containing disalts is transported to a drier where the disalts are dried, and wherein optionally other disalts, calcium/magnesium salts and/or a desiccant can be added to the drier.

2. Method according to claim 1,
   characterised in that
   a 80-95 % aqueous solution of formic acid is reacted with a solution of 70-80 % potassium or sodium formate at 50-60°C in a first reactor and subsequently cooled to 20-25°C, whereby the formed diformate precipitates, in that the slurry containing the diformate is separated and the filtrate is transferred to a second reactor where it is reacted with a 50 % solution of NaOH or KOH, which optionally may be mixed with the corresponding alkali carbonate, in that the thus formed formate solution is adjusted to pH 9-10 and then evaporated to a 70-80 % solution which is transferred to said first reactor, and in that the separated diformate solids are dried by means of air to a water content of <0.2 % in said drier.

3. Method according to claim 1,
   characterised in that
   mole-ratio of K-, Cs-, Na- or NH_4-carboxylate and formic acid is 1-1.5 : 1-1.5, and in that the filtration is performed by means of a centrifuge.

4. Method according to claim 1 or claim 3,

characterised in that
the temperature in the reactor is between 50-70°C and the concentration of the acid is between 50-100 %.

5. Method according to claim 1, claim 3 or claim 4, **characterised in that** there is used a K/Na-carbonate/hydroxide which is solid and which has a water content from 1-15 %.

6. Method according to claim 1, claim 3 or claim 4 **characterised in that** liquid and/or gaseous NH_3 or ammonium formate is mixed with formic acid.

7. Method according to claim 1 or any one of claims 3-6, **characterised in that** the disalts are dried at temperatures between 40 and 80°C, preferably between 50 and 70°C.

8. Products comprising disalts of formic acid, **characterised in that** the general composition of the products is

20-60 %	potassium disalt
20-50 %	sodium di/tetra salt
0-25 %	calcium mono salt
0-4 %	desiccant
0-5 %	water

9. Products comprising disalts of formic acid, **characterised in that** the general composition of the products is

60-99 %	potassium disalt
0-28 %	calcium mono salt
0-4 %	desiccant
0-5 %	water.

Patentansprüche

1. Verfahren zur Herstellung von Produkten, welche Disalze von Ameisensäure enthalten, umfassend das Vermischen von K-, Na-, Cs- oder NH_4-Formiat, K-, Na- oder Cs-Hydroxid, K-, Na- oder Cs-Carbonat oder -Bicarbonat oder NH_3 mit Ameisensäure, welche 0-50 % Wasser enthält, in einem Reaktor bei 40-100°C, dadurch gekennzeichnet, daß die Reaktion laufen gelassen wird bis annähernd 50-55 % der Ameisensäure verbraucht sind, das Gemisch gekühlt wird und die gebildete Aufschlämmung filtriert wird, das Filtrat gesammelt oder rezirkuliert wird und der Disalze enthaltende Filterkuchen zu einem Trockner transportiert wird, wo die Disalze getrocknet werden, und wobei gegebenenfalls andere Disalze, Calcium/Magnesium-Salze und/oder ein Trocknungsmittel zu dem Trockner zugegeben werden können.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß eine 80-95 % wässrige Lösung von Ameisensäure mit einer Lösung von 70-80 % Kalium- oder Natriumformiat bei 50-60°C in einem ersten Reaktor umgesetzt wird und anschließend auf 20-25°C gekühlt wird, wobei das gebildete Diformiat präzipitiert, daß die das Diformiat enthaltende Aufschlämmung abgetrennt wird und das Filtrat zu einem zweiten Reaktor transferiert wird, worin es mit einer 50 % Lösung von NaOH oder KOH, welche gegebenenfalls mit dem entsprechenden Alkalicarbonat gemischt sein kann, umgesetzt wird, und die derart gebildete Formiatlösung auf einen pH-Wert von 9-10 eingestellt wird und danach auf eine 70-80 % Lösung eingedampft wird, welche zum ersten Reaktor transferiert wird, und daß die abgetrennten Formiatfeststoffe in dem Trockner mittels Luft bis zu einem Wassergehalt von <0,2 % getrocknet werden.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Molverhältnis von K-, Cs-, Na- oder NH_4-Carboxylat und Ameisensäure 1-1,5 : 1-1,5 beträgt, und daß die Filtration mittels einer Zentrifuge ausgeführt wird.

4. Verfahren nach Anspruch 1 oder Anspruch 3, dadurch gekennzeichnet, daß die Temperatur im Reaktor zwischen 50-70°C beträgt und die Konzentration der Säure zwischen 50-100 % ist.

5. Verfahren nach Anspruch 1, Anspruch 3 oder Anspruch 4, dadurch gekennzeichnet, daß ein K/Na-Carbonat/Hydroxid verwendet wird, das ein Feststoff ist und einen Wassergehalt von 1 bis 15 % hat.

6. Verfahren nach Anspruch 1, Anspruch 3 oder Anspruch 4, dadurch gekennzeichnet, daß flüssiges oder gasförmiges NH_3 oder Ammoniumformiat mit Ameisensäure gemischt wird.

7. Verfahren nach Anspruch 1 oder einem der Ansprüche 3 bis 6, dadurch gekennzeichnet, daß die Disalze bei Temperaturen zwischen 40 und 80°C, bevorzugt zwischen 50 und 70°C getrocknet werden.

8. Produkte, umfassend Disalze von Ameisensäure, dadurch gekennzeichnet, daß die allgemeine Zusammensetzung der Produkte

20-60 %	Kaliumdisalz
20-50 %	Natriumdi/tetrasalz

(fortgesetzt)

0-25 %	Calciummonosalz
0-4 %	Trocknungsmittel
0-5 %	Wasser ist.

9. Produkte, umfassend Disalze von Ameisensäure, dadurch gekennzeichnet, daß die allgemeine Zusammensetzung der Produkte

60-99 %	Kaliumdisalz
0-28 %	Calciummonosalz
0-4 %	Trocknungsmittel
0-5 %	Wasser ist.

Revendications

1. Procédé de fabrication de produits contenant des disels d'acide formique, comprenant le mélange de formiate de K, Na, Cs ou NH_4, d'hydroxyde de K, Na ou Cs, de carbonate ou de bicarbonate de K, Na ou Cs ou de NH_3 avec de l'acide formique contenant 0-50% d'eau dans un réacteur à 40-100°C, caractérisé en ce que
la réaction est conduite jusqu'à ce qu'environ 50-55% de l'acide formique aient été consommés, le mélange est refroidi et la suspension formée est filtrée, le filtrat est recueilli ou recyclé et le gâteau de filtration contenant des disels est transféré à un sécheur où les disels sont séchés, et où. le cas échéant d'autres disels, des sels de calcium/magnésium et/ou un agent desséchant peuvent être ajoutés au sécheur.

2. Procédé suivant la revendication 1, caractérisé en ce que
une solution aqueuse à 80-95% d'acide formique est amenée à réagir avec une solution à 70-80% de formiate de potassium ou de sodium à 50-60°C dans un premier réacteur puis le mélange est refroidi à 20-25°C, ce qui fait précipiter le diformiate formé, en ce que la suspension contenant le diformiate est séparée et le filtrat est transféré à un second réacteur dans lequel il est amené à réagir avec une solution à 50% de NaOH ou de KOH, qui peut facultativement être mélangée avec le carbonate alcalin correspondant, en ce que la solution de formiate ainsi formée est ajustée à un pH de 9-10 puis évaporée, ce qui donne une solution à 70-80% qui est transférée au premier réacteur, et en ce que le diformiate solide séparé est séché au moyen d'air jusqu'à une teneur en eau inférieure à 0,2% dans le sécheur.

3. Procédé suivant la revendication. 1, caractérisé en ce que
le rapport molaire du carboxylate de K, Cs, Na ou NH_4 à l'acide formique est de 1-1,5:1-1,5 et en ce que la filtration est effectuée au moyen d'une centrifugeuse.

4. Procédé suivant la revendication 1 ou la revendication 3, caractérisé en ce que
la température dans le réacteur est comprise entre 50 et 70°C et la concentration de l'acide est comprise entre 50 et 100%.

5. Procédé suivant la revendication 1, la revendication 3 ou la revendication 4, caractérisé en ce qu'on utilise un carbonate/hydroxyde de K/Na qui est solide et dont la teneur en eau va de 1 à 15 %.

6. Procédé suivant la revendication 1, la revendication 3 Ou la revendication 4, caractérisé en ce que du NH_3 liquide et/ou gazeux ou du formiate d'ammonium est mélangé avec de l'acide formique.

7. Procédé suivant la revendication 1, ou l'une quelconque des revendications 3 à 6, caractérisé en ce que les disels de Na et de K sont sèches à des températures comprises entre 40 et 80°C, de préférence entre 50 et 70°C.

8. Produits comprenant des disels d'acide formique, caractérisés en ce que
la composition générale des produits est:

20-60%	de disel de potassium
20-50%	de di/tétrasel de sodium
0-25%	de monosel de calcium
0-4%	d'agent desséchant
0-5%	d'eau

9. Produits comprenant des disels d'acide formique, caractérisés en ce que la composition générale des produits est:

60-99%	de disel de potassium
0-28%	de monosel de calcium
0-4%	d'agent desséchant
0-5%	d'eau

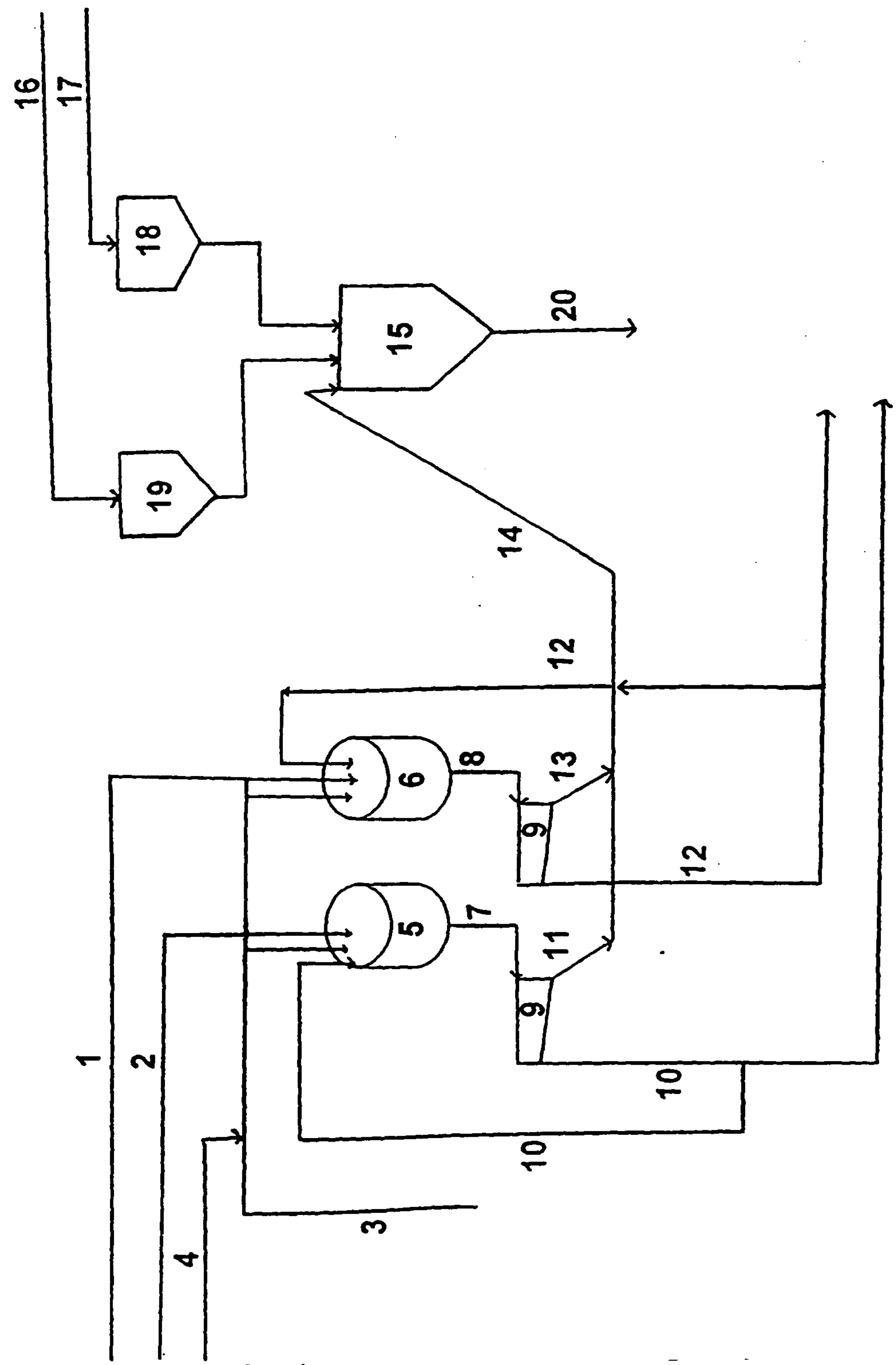

FIG. 1

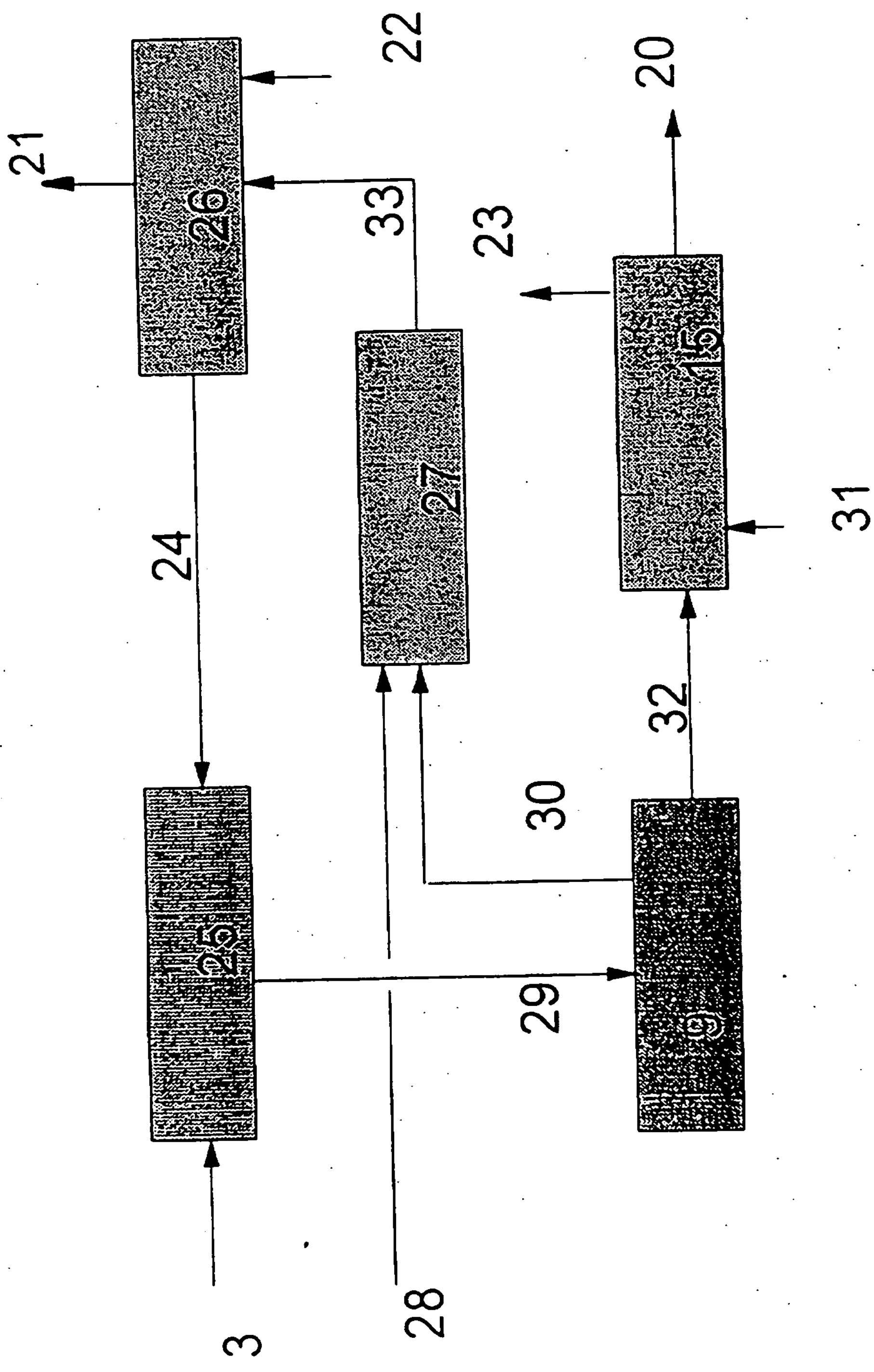

Fig. 2